Studies in Andean *Ocotea* (Lauraceae). I. Species with Hermaphrodite Flowers and Fistulose Twigs Occurring Above 1000 m Altitude

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Abstract. A key to and descriptions of the seven species of *Ocotea* Aubl. (Lauraceae) with bisexual flowers and fistulose twigs occurring in the Andes are presented. Of the seven species, five are newly described: *O. beekmanii* van der Werff, *O. cuatrecasasii* van der Werff, both from Colombia, *O. fistulosa* van der Werff from Ecuador, *O. magnifrons* van der Werff described from Ecuador and also in Colombia, and *O. obovatifolia* van der Werff from Ecuador.

Key words: Andes, Colombia, Ecuador, IUCN Red List, Lauraceae, *Ocotea*.

The genus *Ocotea* Aubl. is without doubt the largest genus of Lauraceae in the Neotropics. Rohwer (1993) gave a total of ca. 300 species. However, new species have been published regularly since 1993, and van der Werff (2011) estimated that the number of species would be between 350 and 400. Species of *Ocotea* occur from Mexico to Argentina and are most common in wet, evergreen forests from sea level to the tree line. In northern Ecuador, for example, *Ocotea* species are an important component of forests at 3200 m altitude. The American species were last revised by Mez (1889); however, the large number of species makes a new revision unlikely. There have been regional treatments, such as a synopsis for the Flora MesoAmericana region (van der Werff, 2002a), and contributions to regional floras, such as for the *Flora of the Venezuelan Guayana* (van der Werff, 1999), the *Ocotea* species from the Reserva Florestal Ducke near Manaus (van der Werff & Vicentini, 2000), the *Guide to the Vascular Plants of Central French Guiana* (van der Werff, 2002b), and the *Flora del Rio Cenepa, Amazonas, Peru* (van der Werff, 2010).

Ocotea is characterized by flowers with six equal tepals and nine 4-locular stamens, the locelli arranged in two superposed pairs, a lack of staminodia, or when present, the staminodia stipitiform, and the fruit seated in a shallow or deep cupule. Flowers can be unisexual or perfect. Rohwer (1986) gave an overview of the genus, including keys to species groups and species, based largely on a study of type specimens. This publication has greatly facilitated subsequent studies with the informal description of a large number of species groups. Rohwer's *O. aciphylla* (Nees) Mez species group is represented by several species in the Andean region. It is characterized by hermaphrodite flowers, densely pubescent inner surfaces of the tepals, pubescent staminodia, a deep receptacle, and a deep cupule (Rohwer, 1986: 115). Additional characters include deeply canaliculate petioles, lack of domatia, and basal secondary veins positioned closer together than the distal ones (van der Werff, pers. obs.). Chanderbali et al. (2001) published a large phylogeny of Neotropical Lauraceae and showed that *Ocotea* as traditionally circumscribed is almost certainly polyphyletic. Five distinct clades were recognized among the Neotropical species, but the number of South American species investigated was small. However, before relationships between the species can be studied in a meaningful way, it will be necessary to describe all the species comprehensively. Making the species known is the aim of this and subsequent publications.

Lauraceae in the Andean region are poorly known in comparison to Lauraceae in the South American lowlands. Based on the earliest collections by Ruiz and Pavon, Mutis, and Humboldt and Bonpland, a relatively small number of species (ca. 18) currently placed in *Ocotea* were described. Based on collections by Hartweg, Stuebel, Purdie, Karsten, and Linden, a few more species were described, but the total number of *Ocotea* species known from the Andes remained low. Collections from the early 20th century by Sodiro and especially Weberbauer yielded many additional species described by Mez (1904, 1906) and later by Schmidt (1933). In the second half of the 20th century, Cuatrecasas made excellent collections in Colombia, but his Lauraceae specimens have not yet been comprehensively studied. In the latter part of the last century, several institutions and particularly the Missouri Botanical Garden initiated intensive collecting programs in the Andean region, especially in Ecuador and Peru. From this, several *Ocotea* species have been described (van der Werff, 1991, 1994, 2003). However, the number of unidentified collections remains large and includes

a number of undescribed species. In this publication, a first step will be made toward describing the Andean species of *Ocotea*, restricted to those occurring above 1000 m altitude in the Andes of Venezuela, Colombia, Ecuador, Peru, and Bolivia. Descriptions of all the species and keys to species will be presented. In the case of known species represented by many collections, only selected specimens will be cited. Additional collections can be found on Tropicos (<http://www.tropicos.org>), the database of the Missouri Botanical Garden. The species will be divided into groups based on readily observable morphological characters. No attempt has been made to present monophyletic groups at this time. Once species have been described, it will be possible to study their relationships, but this cannot be done while so many species are unknown. Even though a substantial number of new species will be published in this and subsequent publications, additional new species can still be expected. Our knowledge of the species in Colombia is especially poor due to civil unrest in that country and the difficulty of sending botanical specimens abroad. Experience in better-explored Ecuador and Peru shows that once collecting starts in any undisturbed area with montane forest, new species of *Ocotea* are encountered.

In this contribution, seven species of *Ocotea* with bisexual flowers and fistulose stems are presented. Although sometimes the fistulose stems are not conspicuous, all these species have thick twigs that abruptly narrow at the tip (in species with solid stems, the twigs narrow gradually toward the tip) and small pores or longitudinal slits in the stems and/or inflorescences through which the ants can enter or exit the hollow stems. Specimen labels often mention the presence of ants in the hollow twigs, but there are only two references to the presence of aggressive ants, both in lowland collections of *O. javitensis* (Kunth) Pittier. In *O. fistulosa* van der Werff, the ants do not leave the hollow twigs after they are cut, and the twigs are lined on the inside with a black layer, suggesting that the ants are cultivating a fungus (van der Werff, pers. obs.).

IUCN Red List category. Most of the species described here are known from few collections. They could be assessed as threatened or vulnerable based on the IUCN (2001) criteria because of the general trend toward deforestation in the Andean region. However, because no specific threats are known, I prefer to assess them as Data Deficient (DD) with the exception of *Ocotea javitensis*, which I assess as Least Concern (LC).

KEY TO ANDEAN SPECIES OF *OCOTEA* WITH BISEXUAL FLOWERS AND FISTULOSE TWIGS OCCURRING ABOVE 1000 M ALTITUDE

1a. Lower leaf surface completely covered by the indument 2
1b. Lower leaf surface glabrous to moderately appressed pubescent, the surface at least partly visible 3
2a. Midrib and secondary veins impressed on the upper leaf surface and prominently raised on the lower surface; petiole flat above .... *O. cuatrecasasii*
2b. Major veins immersed on the upper leaf surface and not or weakly raised on the lower surface; petiole strongly canaliculate ..... *O. beekmanii*
3a. Leaf base inrolled and decurrent on the petiole, petiole winged to the base ..... *O. fistulosa*
3b. Leaf base flat, not decurrent on the petiole or if somewhat decurrent and inrolled, basal 1–2 cm of the petiole free, not winged 4
4a. Lower surface of leaves glaucous ..... *O. amplissima*
4b. Lower surface of leaves green, not glaucous 5
5a. Lateral veins loop-connected in the distal 1/2 of the lamina; fronds broadly elliptic, large, 25–55 × 11–25 cm, tips shortly acuminate or acuminate ..... *O. magnifrons*
5b. Lateral veins free, not loop-connected; fronds elliptic to obovate, to 35 × 15 cm, tips acute or obtuse 6
6a. Twigs angular; leaf apices obtuse; cupule plate-like, undulate, with a single margin .... *O. obovatifolia*
6b. Twigs terete; leaf apices acute or acuminate; cupule cup- or bowl-shaped, not undulate, often weakly double-margined ..... *O. javitensis*

I. Ocotea Aubl., Hist. Pl. Guiane 2: 780–781, tab. 310. 1775. TYPE: *Ocotea guianensis* Aubl.

1. Ocotea amplissima Mez, Repert. Spec. Nov. Regni Veg. 3: 68. 1906. TYPE: Peru. Huanuco: Huamalies, mtns. SW of Monzon, 2000–2500 m, 8 Aug. 1903, *Weberbauer 3550* (holotype, B; isotype, G not seen).

Shrubs, 3 m, or trees, 22 m; twigs angular, hollow, 10–12 mm diam., densely and minutely appressed pubescent when young, becoming glabrous with age; terminal buds densely pubescent. Leaves 18–30 × 6.5–12 cm, alternate, elliptic to elliptic-ovate, stiffly chartaceous, the base flat, acute to obtuse, the distal 1/2 gradually narrowed, the apex acute, upper surface glabrous, the lower surface glaucous, glabrous, but with some appressed hairs on the midrib below; venation immersed on the upper surface; midrib and secondary veins raised on the lower surface, tertiary veins immersed; domatia absent; secondary veins in 8 to 11 pairs; petioles 1–1.7 cm, strongly canaliculate, not winged. Inflorescences 8–16 cm, densely flowered, paniculate-cymose, densely appressed pubescent. Flowers green, 2.5 mm diam. (not quite mature), moderately pubescent on the outer surface; immature tepals with a few hairs at the base, otherwise

glabrous, on the inner surface; stamens 9, all 4-celled; staminodia stipitiform, densely pubescent; pistil glabrous, receptacle deep, glabrous inside. Immature fruit 1 cm diam., largely enclosed in the cupule.

Discussion. The type collection of *Ocotea amplissima* is a 3 m shrub that has inflorescences with many buds but lacks open flowers. The second collection (a 22 m tree) also has buds and immature fruits. Therefore, no measurements of the floral parts are given in the description above. The species is well defined by its large, glaucous leaves and thick, fistulose twigs. The specific epithet refers to the large, branched inflorescences. Rohwer (1986) included this species in his *O. aciphylla* species group. The two collections cited for *O. amplissima* were made in central Peru between 2000 and 2500 m altitude.

Additional specimen seen. PERU. **Pasco:** Oxapampa, Distr. Huancabamba, ca. de la Laguna San Daniel, *Monteagudo et al. 9311* (MO).

2. Ocotea beekmanii van der Werff, sp. nov. TYPE. Colombia. Antioquia: Mpio. Urrao, Parque Nac. Nat. "Las Orquídeas," 06°32′N, 76°19′W, 1450 m, 1 Dec. 1993, *A. Cogollo, A. Duque, F. Giraldo, W. Rodriguez & E. Alvarez 7633* (holotype, MO-04982546; isotype, NY). Figure 1.

Ocoteae amplissimae Mez similis, sed ab ea receptaculo intus pubescenti et foliis latioribus abaxialiter dense rufo-pubescentibus (nec glaucis trichomatibus adpressis praeditis) recedit.

Trees, to 17 m; twigs angular, hollow, (5–)7–11 mm diam., densely to moderately appressed pubescent; terminal buds densely and minutely appressed pubescent. Leaves 18–34 × 7.5–15 cm, alternate, elliptic to broadly elliptic, firmly chartaceous, the base obtuse to rounded, rarely acute, sometimes decurrent on the petiole, the apex obtuse to acuminate, the acumen to 2 cm, but often broken off, the upper blade surface glabrous, the lower surface minutely and densely reddish brown pubescent, the hairs short and appressed, the indument becoming sparser with age; venation immersed on the upper surface; midrib raised, secondary veins weakly raised and tertiary venation immersed on the lower surface; domatia absent; secondary veins 6 to 8 on each side of the leaf; petioles 2–4 cm, canaliculate, moderately to sparsely appressed pubescent. Inflorescences ca. 10 cm, paniculate-cymose, moderately to densely pubescent, the hairs appressed or ascending, in the axils of leaves. Flowers yellowish, ca. 5 mm diam., pedicels 2 mm; tepals 2 mm, densely pubescent on the outer surface, sparsely pubescent on the inner surface, spreading at anthesis; stamens 9, 1 mm, the filaments pubescent, the anthers glabrous, 4-celled, glands present at the base of the inner stamens, globose, ca. 0.5 mm; staminodia present, 0.5 mm, pubescent; pistil glabrous, 2.5 mm, receptacle deep, densely pubescent inside. Fruit ellipsoid, 4 × 2.3 cm, cupule 1.6 cm high, 2.6 cm diam., deeply cup-shaped, glabrous, faintly double-margined.

Discussion. *Ocotea beekmanii* is closely related to *O. amplissima*, and both belong to the *O. aciphylla* species group. It differs from *O. amplissima* in having a densely pubescent inner surface of the receptacle (vs. glabrous in *O. amplissima*) and in the reddish brown indument on the lower leaf surface (vs. lower leaf surface glaucous and sparsely appressed pubescent in *O. amplissima*). The leaf shape is also different: *O. beekmanii* has broader leaves that are often acuminate compared to *O. amplissima*, which has leaves that gradually taper into an acute tip.

Rohwer (1986) lists two additional species of the *Ocotea aciphylla* species group with hollow twigs, *O. laticostata* C. K. Allen and *O. javitensis*. *Ocotea laticostata* is known from Venezuelan Guayana and differs in having the margins of the leaves revolute, the lower leaf surfaces glabrous or nearly so, and the tepals sparsely pubescent on the outer surface. *Ocotea javitensis* lacks the reddish brown pubescence on the lower leaf surface; its leaves are glabrous or bear few appressed hairs.

Ocotea beekmanii has been collected several times during an inventory of a permanent plot (Parcela G) in the Parque Nacional Natural "Las Orquídeas" in Mpio. Urrao, Antioquia, Colombia, at an altitude of 1450 m. Most of these collections are sterile. The type collection has a small inflorescence, and it is possible that additional collections will show that inflorescences can be larger. Although the fruits are quite large, they are described by the collectors as immature and green. Collections have been previously identified as *O. aciphylla*, and duplicates may have been distributed under that name.

Ocotea beekmanii is dedicated to the late E. M. Beekman (1939–2008), linguist, poet, and translator of Rumphius's *Herbarium Amboinense*.

Paratypes. COLOMBIA. **Antioquia:** Mpio. Urrao, Parque Nac. Nat. "Las Orquídeas," 06°32′N, 76°19′W, 1450 m, 15–20 Oct. 1993, *A. Cogollo, A. Duque, F. Giraldo, W. Rodriguez & J. Velez 6891, 6898, 6935, 6938, 6990, 7212, 7968* (all at MO), 14–17 Aug. 1993, *A. Cogollo, A. Duque, F. Giraldo, W. Rodriguez, W. Ramirez & E. Alvarez 6430, 6432, 6436, 6481, 6488, 6510, 6514, 6555, 6560, 6571, 6575* (all at MO), 11–26 Nov. 1993, *A. Cogollo, A. Duque,*

Figure 1. *Ocotea beekmanii* van der Werff (*Cogollo et al. 7245*, MO).

F. Giraldo, W. Rodriguez & E. Alvarez 7245 (MO, NY), *7254* (MO), *7255* (MO), *7305* (MO), *7461* (MO).

3. Ocotea cuatrecasasii van der Werff, sp. nov. TYPE: Colombia. Dpto. del Valle: Cordillera Occidental, Hoya del Rio Alban, Quebrada Robada, Alto Bonito, 1800–1900 m, 20 Oct. 1946, *J. Cuatrecasas 22355* (holotype, US-2267151; isotypes, P, U-362766 [fls.], U-362767 [st.]). Figure 2.

Figure 2. Holotype of *Ocotea cuatrecasasii* van der Werff (*Cuatrecasas 22355*, US).

A speciebus ramulis fistulosis ac foliorum venis majoribus impressis praeditis, petiolis adaxialiter applanatis et tepalis patentibus recedit.

Large trees, to 18 m or more; twigs hollow, with a small lumen, or solid, 7–8 mm diam., brown tomentulose or puberulous, the indument covering the surface completely, but paler and wearing off on older twigs; terminal buds densely pubescent. Leaves 11–18 × 6–10 cm, alternate, elliptic to broadly elliptic, coriaceous, the base cuneate to

acute, the apex obtuse or bluntly acute, the margin slightly revolute, the lower surface densely and minutely tomentulose, in sicco brown with a bluish tinge, the upper surface minutely and sparsely tomentulose, especially near the base, the hairs falling off with age and the upper surface becoming lustrous; midrib and lateral veins impressed, tertiary venation immersed on the upper surface; midrib and lateral veins prominently raised, tertiary venation slightly raised and scalariform on the lower surface; domatia absent; lateral veins 8 to 10 on each side of the leaf; petioles 9–12 mm, flat above, minutely tomentulose. Inflorescences mostly in the axils of bracts at the base of seasonal growth, to 22 cm, paniculate-cymose, densely brown tomentulose. Flowers yellowish, 5–6 mm diam.; tepals 6, spreading, 2–2.5 × 2 mm, the tip rounded, densely pubescent on the inner surface, tepals and receptacle densely brown pubescent outside; stamens 9, all 4-locular, the outer 6 ca. 1 mm, the glabrous filament 1/3 as long as the anther, the anther bent toward the center of the flower, inner stamens 1.5 mm, erect, glands present at the base of the inner stamens; staminodia absent; pistil 2.5 mm, glabrous, the style 0.6 mm, receptacle cup-shaped, glabrous inside. Fruit and cupule not known.

Discussion. Among the *Ocotea* species with fistulose twigs, *O. cuatrecasasii* stands apart by the impressed major veins on the upper leaf surface and the strongly raised veins on the lower leaf surface. It differs from taxa in the *O. aciphylla* species group in having flat (not canaliculate) petioles, impressed veins, an absence of staminodia, and spreading (not erect or half-erect) tepals. It is probably closely related to three other undescribed Andean species with impressed major veins, flat petioles, and spreading tepals. These undescribed species (with solid stems) are represented by more collections and are probably gynodioecious; plants can have either bisexual or pistillate flowers. It is likely that *O. cuatrecasasii* is also gynodioecious; the single flowering collection has bisexual flowers.

The isotype of *Ocotea cuatrecasasii* (*J. Cuatrecasas 22355*, P) has not only fistulose twigs, but also fistulose inflorescences with small pores through which the ants can enter or leave. The paratype, *Vargas 6084* (MO), has a solid, thick stem, but with slits, which give access to the core of the stem.

Ocotea cuatrecasasii is named after J. Cuatrecasas (1903–1996), eminent botanist, whose collections have added significantly to our knowledge of the Colombian flora.

Ocotea cuatrecasasii is known from two collections from the Cordillera Occidental in Colombia growing between 1800 and 2300 m. The single flowering collection was made in October and represents the holotype.

Paratype. COLOMBIA. **Risaralda:** Mpio. de Santuario, Reserva Planes de San Rafael, 2000–2300 m, May 1999, *W. Vargas 6084* (MO).

4. Ocotea fistulosa van der Werff, sp. nov. TYPE: Ecuador. Carchi: in secondary cloud forest above Maldonado, 31 July 1989, 2400 m, *H. van der Werff & E. Gudiño 10800* (holotype, MO-6327519 [fls.], MO-6327520 [frs.]; isotypes, B, COL, F, HBG, K, MA, NY, QCA, QCNE, US). Figures 3, 4.

Ocoteae amplissimae Mez affinis, sed ab ea basibus foliorum decurrentibus revolutisque diversa est.

Trees, to 16 m; twigs angular, hollow, thick, 10–12 mm diam., moderately to densely appressed gray-pubescent; terminal buds densely appressed pubescent. Leaves 33–47 × 12–19 cm, alternate, elliptic, firmly chartaceous, toward the base inrolled and decurrent on the petiole, the apex obtuse or somewhat acute, the upper surface sparsely appressed pubescent, becoming glabrous with age, lower surface moderately to densely appressed pubescent; venation immersed on the upper surface; midrib and secondary veins raised, tertiary veins immersed on the lower surface; domatia absent; lateral veins 10 to 14 on each side of the leaf; petioles ca. 1.5 cm, canaliculate, with decurrent leaf margins to the base. Inflorescences 15–30 cm, densely flowered, paniculate-cymose, in the axils of leaves, to 7 mm diam. at the base, angular, hollow and moderately pubescent near the base, densely pubescent distally. Flowers green or yellowish green, 4–5 mm diam., pedicels 2–3 mm; tepals 6, ca. 2 mm, densely pubescent outside, sparsely pubescent on the inner surface, spreading at anthesis; stamens 9, all 4-celled, ca. 0.8 mm, the anthers glabrous, the short filaments with some scattered hairs, stamens of third whorl with 2 globose glands at the base; staminodia present, stipitiform, ca. 0.5 mm; pistil and inside of the receptacle glabrous. Immature fruit 2.2 × 1.2 cm, ellipsoid, the cupule bowl-shaped, 1.5 cm diam., 0.8 cm high, the tepals persisting as weak triangular teeth.

Discussion. *Ocotea fistulosa* can be confused with *O. obovatifolia* van der Werff but differs in its denser pubescence on leaves, inflorescences, and flowers, its shorter pedicels (2–3 mm vs. 4–5 mm), and the elliptic (vs. obovate or obovate-elliptic) leaves.

Ocotea fistulosa resembles *O. amplissima* in its large leaves, thick, hollow twigs, and densely flowered inflorescences. However, its decurrent and inrolled leaf

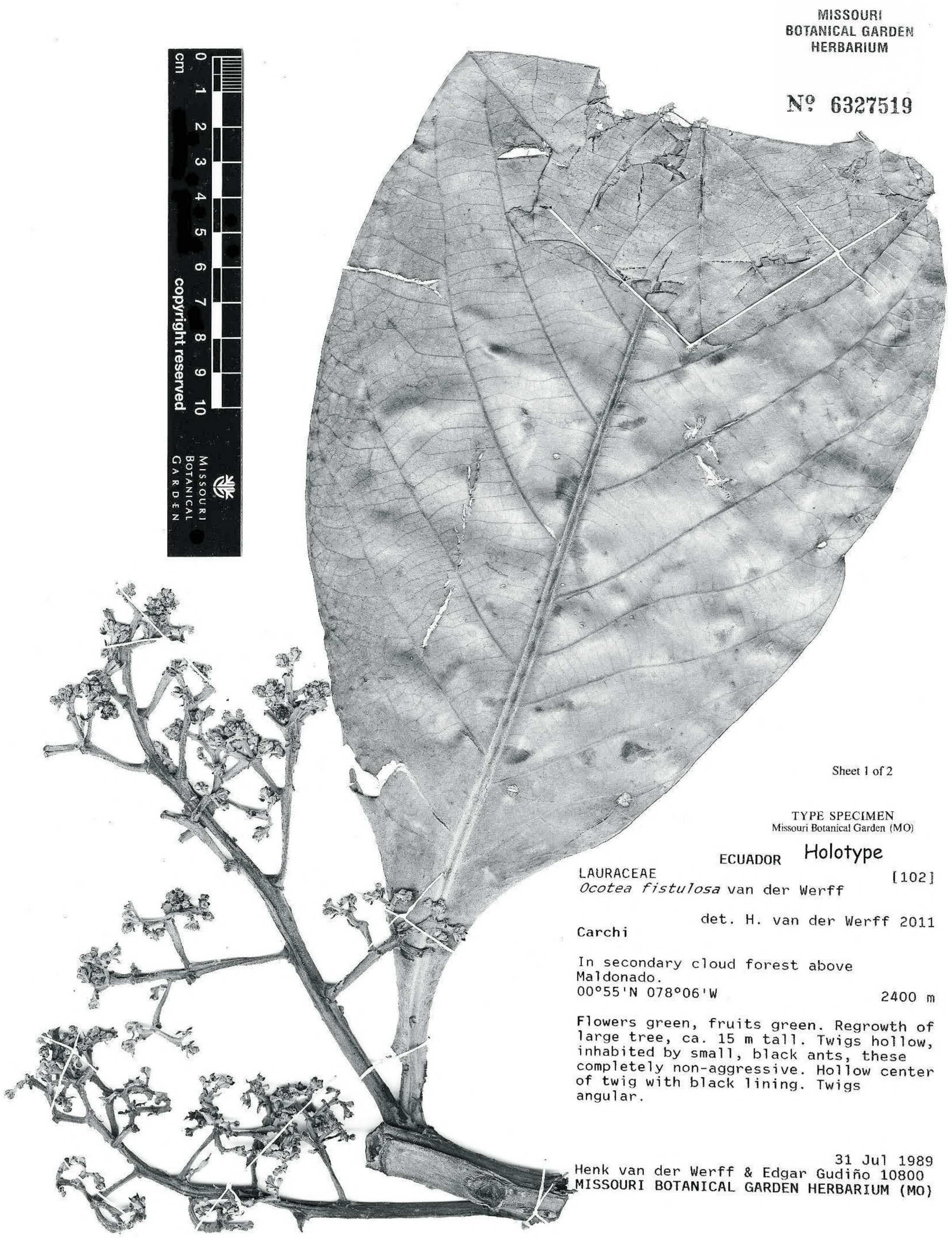

Figure 3. Holotype of *Ocotea fistulosa* van der Werff (flowering sheet; *van der Werff & Gundiño 10800*, MO-6327519).

bases make it amply distinct. The inside of the hollow twigs is covered with a black lining and is inhabited by small, non-aggressive ants (van der Werff, pers. obs.). *Ocotea fistulosa* is known from two flowering collections made in northern Ecuador at ca. 2400 m elevation in July and January (from the type *van der Werff & Gudiño 10800* and paratype *Vargas et al. 4368*).

Paratype. ECUADOR. **Carchi:** Espejo, Reserva Golondrinas, 2390 m, *H. Vargas, E. Narváez, W. Torres & P. Escobar 4368* (MO).

Figure 4. Holotype of *Ocotea fistulosa* van der Werff (fruiting sheet; *van der Werff & Gundiño 10800*, MO-6327520).

5. Ocotea javitensis (Kunth) Pittier, Cat. Fl. Venez. 1: 311. 1945. Basionym: *Laurus javitensis* Kunth, Nov. Gen. Sp. [quarto ed.] 2: 169. 1817. TYPE: Venezuela, "in umbrosis sylvarum Orinocensium juxta Javitam," *Humboldt 949* (holotype, P not seen).

Trees, to 35 m; twigs terete, hollow, infrequently slightly ridged, to 5 mm diam., smooth or lenticellate,

densely and minutely pubescent, often with small pores and inhabited by ants; terminal buds densely appressed pubescent. Leaves 10–30 × 4.5–10 cm, alternate, elliptic or obovate, firmly chartaceous, pinnately veined, the base acute to obtuse, the apex acute or acuminate, the acumen to 1.5 cm, the margin flat, glabrous on both surfaces; venation immersed on the upper surface; midrib and lateral veins somewhat raised on the lower surface; domatia absent; lateral veins 7 to 12 on each side of the leaf, evenly spaced; petioles 1–2 cm, canaliculate, finely appressed pubescent to glabrous. Inflorescences 3–10 cm, paniculate-cymose or the flowers arranged in dense, short fascicles, in the axils of leaves or bracts, occasionally along leafless short shoots, sparsely to densely pubescent, the hairs appressed or erect. Flowers white or creamish white, fragrant, 2–6 mm diam., pedicels 4–6 mm, glabrous or pubescent; tepals 6, equal, 1.5–3 mm, elliptic, erect or half-erect, the outer surface glabrous to densely pubescent, inner surface glabrous to pubescent; stamens 9, all 4-locular, the outer six 1–1.5 mm, the thecae introrse, the filaments 1/2 as long as the anthers, pubescent, inner 3 stamens with the thecae extrorse, with the same dimensions as the outer stamens, 2 globose glands present at the base of the inner stamens; staminodia present, stipitate, pubescent; pistil ca. 2 mm, glabrous, the ovary 1/2 as long as the style, receptacle deep, glabrous or pubescent inside. Fruit 1.5–3 × 1.3–2 cm, cupule weakly double-margined, sometimes appearing with a single margin, shallow, bowl-shaped, 6 mm high, 10 mm wide or deeper, cup-shaped, to 1.3 × 2.3 cm.

Discussion. *Ocotea javitensis* is a variable species, best recognized by its somewhat obovate leaves, terete, fistulose twigs, erect or half-erect tepals, and cupules with a faint double margin. Specimens assigned to this species vary in floral characters: flowers can be glabrous to densely pubescent, the inside of the receptacle can be glabrous or pubescent, and the diameter of the flowers ranges from 2 to 6 mm. The cupules are also variable appearing as bowl-shaped to cup-shaped. These differences in flowers and cupules are striking, but because specimens rarely have flowers and fruits, it is not possible to correlate particular flower types with particular cupule types. Although not all specimens mentioned in the discussion below are cited among the selected specimens here, I accept them as belonging to *O. javitensis*. The specimens of *O. javitensis* with the largest flowers and pubescent receptacles have been collected in Ecuador, mostly at altitudes above 1000 m, but *Palacios 12839* (MO), from 300 m, has these characters as well. The largest cupules and fruits are found on a specimen collected at 800 m altitude in Ecuador; this specimen (*van der Werff & Palacios 10357*, MO) has densely pubescent and relatively small (2.8 mm diam.) flowers. Although some flowering specimens come from tall trees (35 m, *Hurtado 1179*, MO), others are much smaller (7 m, *Brandbyge 30422*, MO). Unfortunately, size is not correlated with flower type either: the *Brandbyge* specimen has glabrous flowers, while *van der Werff & Palacios 10357* (10 m) has densely pubescent flowers.

There is also considerable variation in inflorescence type. Some collections show the paniculate-cymose inflorescence common in Lauraceae (for instance, *Arias 07* and *Neill et al. 8116*, both at MO), but other collections have fascicles of flowers along twigs or along inflorescences (for instance, *Brandbyge 30422* and *Klug 4324*, both at MO). In the latter case, the twigs or inflorescences are conspicuously swollen and have a large cavity. *Gudiño 321* (MO) has flowers fasciculate along short shoots with pedicels to 1.1 cm. In specimens with the flowers fasciculate along the main inflorescence axis, the inflorescence axis is thick and fistulose (to 7 mm diam., *Klug 4324*), while in specimens with regular paniculate-cymose inflorescences, the inflorescence axis is only 2 mm diam. Twigs with fascicles of flowers are also thicker (to 7 mm diam., *Romoleroux 2789*, MO) and with a larger lumen than twigs without such inflorescences.

There are many collections with somewhat condensed inflorescences and not as strongly swollen twigs. Several labels (e.g., *Palacios 4139*, *10864*) mention the presence of ants in the hollow stems, and probably several species of ants inhabit the twigs. Some labels mention red ants, and others mention black ants; the ants are described as aggressive or non-aggressive. If or how the presence of ants in the hollow twigs or inflorescences induce the fasciculate flower arrangement is not known. Since it was not possible to divide the specimens in groups that differed by more than one character, it seemed better to treat all specimens as one variable species.

Similar to *Ocotea javitensis* is *O. costulata* (Nees) Mez, a widespread lowland species (Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela) with hollow, ant-inhabited twigs; it differs in its narrower leaves with a dense, minute, and appressed indument on the lower leaf surface, more acute and often inrolled leaf bases, and deeper cupules. *Ocotea costulata* is not known from the Andean region.

IUCN Red List category. Because of its wide distribution and the large number of available

collections, *Ocotea javitensis* is assessed as Least Concern (LC) based on the IUCN (2001) criteria.

Ocotea javitensis is commonly known as Roble Alcanfor (Peru, *Pariona 07*, MO), Efuina (Huitoto Indians, Peru, *Klug 2140*, MO), Quillu ajua (*Alvarado 245*, MO; *Palacios 4139*, MO, QCNE) or Ajua (Quichua, Ecuador, *Zuleta 345*, MO, QCNE), Canelo Amarillo (Ecuador), Pinchimuyo (Ecuador, *Palacios 10864*, MO, QCNE), and Eeáya (Achual Jivaro, Peru, *Lewis et al. 11157*, MO).

This species is distributed in Venezuela, Colombia, Ecuador, Peru, Brazil, and Bolivia. The single collections from Bolivia and Brazil are sterile and their identifications are tentative. *Ocotea javitensis* is found at elevations from 110 to 2000 m.

Selected specimens seen. BOLIVIA. **La Paz:** Franz Tamayo Prov., Serranía de Chepite, *Killeen 3717* (MO). BRAZIL. **Acre:** upper Río Moa near Fazenda Arizona, *Campbell et al. 8367* (MO). BRITISH GUYANA. *Schomburgk 987* (B, P not seen). COLOMBIA. **Antioquia:** rd. betw. Amalfi & Medellín, *MacDougal & Betancur 4104* (MO). ECUADOR. **Carchi:** Tulcan Canton, Reserva Indígena Awá, Rubio, *Quelal & Nastacuaz 1739* (MO). **Esmeraldas:** San Lorenzo Canton, Parroquia Alto Tambo, *Quelal, Tipaz & Grijalva 329* (MO). **Morona-Santiago:** Cordillera de Cutucú, Centro Shuar Uunsuants/Trnaskutuku, *Palacios, Jaramillo & Nicolalde 15624* (MO). **Napo:** Cantón Archidona, Faldas sur de Volcán Sumaco, *Alvarado 245* (MO). **Zamora:** campamento Miazi, *Jaramillo 14398* (MO). PERU. **Cajamarca:** Distr. Huarango, Caserío El Triunfo, *Rodriguez 1262* (MO). **Cusco:** Distr. Camanti, Cerro Camanti, *Valenzuela, Suclli, Farfán & Carazas 8619* (MO). **Pasco:** Distr. Palcazú, *Rojas, Ortiz, Castillo & Fernandez 4578* (MO). **San Martin:** Rioja–Pomacochas rd., below Venceremos, *Gentry & Smith 45141* (MO). VENEZUELA. **Merida:** above dam site on Rio Caparo, *Liesner & Gonzalez 9264* (MO).

6. Ocotea magnifrons van der Werff, sp. nov. TYPE: Ecuador. Carchi: Rio San Juan valley, 4-hr. walk below Chical, 01°02′N, 78°15′W, 1230–1250 m, 10 June 1993, *B. Boyle, A. Butler & E. Lloyd 2063* (holotype, MO-5162944). Figure 5.

Ocoteae obovatifoliae van der Werff similis, sed ab ea foliis ellipticis venatione in dimidio distali brochidodroma et ramulis puberulis trichomatibus brevissimis erectis obtectis recedit.

Trees, to 30 m; twigs angular, hollow, 4–8 mm diam., densely and minutely puberulous, individual hairs difficult to discern, but surface of twigs completely covered; terminal buds densely pubescent with a similar indument as the twigs. Leaves 25–55 × 11–25 cm, alternate, elliptic to broadly elliptic, thinly chartaceous, the base flat, acute, the apex shortly acuminate or acuminate, the upper surface glabrous, lower surface with a dense and minute indument on the midrib, the indument becoming sparser on the secondary and tertiary venation, the lamina glabrous or nearly so; venation immersed on the upper surface; venation raised on the lower surface (including tertiary and quaternary venation); domatia absent; lateral veins 10 to 12 on each side of the leaf, loop-connected in the distal 1/2; petioles 1.2–1.8 cm, canaliculate, not winged. Inflorescences 10–17 cm, paniculate-cymose, in the axils of leaves, densely and minutely pubescent as are the twigs, sometimes hollow and with a few exit holes for ants near the base. Flowers yellowish green, 2.5–3 mm diam.; tepals 6, ca. 0.8 mm, sparsely to densely puberulous on the outside, sparsely puberulous on the inside; stamens 9, all 4-celled, glabrous, 0.8 mm, the filament 1/2 as long as the anther, inner 3 stamens with 2 glands at the base; staminodia 3, minute, stipitiform, glabrous; pistil glabrous, 1.5 mm, gradually narrowed into the short style, receptacle deep, glabrous inside. Fruit ellipsoid, 2.4 × 1.2 cm, cupule funnel-shaped, 1 cm high, 1.4 cm wide, the margin entire, tepals caducous in fruiting stage.

Discussion. *Ocotea magnifrons* is characterized by its large leaves with the secondary veins loop-connected in the distal half, its hollow, ant-inhabited twigs, and the dense, minute indument on twigs, midrib, and venation of the lower leaf surface. The cupules are funnel-shaped due to the thickened fruiting pedicels. It is similar to *O. obovatifolia*, but that species has narrower, obovate leaves, an indument on the twigs consisting of short, appressed hairs, an absence of indument on the veins of the lower leaf surface, fewer secondary veins (6 to 9 on each side of the leaf) that are not loop-connected, and larger (to 4.5 cm) fruits.

The type for *Ocotea magnifrons* has small (30 cm) leaves, but mature flowers. Most other collections are sterile or fruiting and therefore not suitable as types. *Beltran 38* (MO), a specimen with typically larger leaves and flowers, has its leaves mostly damaged and is, therefore, also not a good choice for type.

Flowering specimens have been collected in February, June, and July.

Paratypes. COLOMBIA. **Nariño:** Mpio. Ricaurte, La Planada, 1800 m, *W. Vargas 1112* (MO); Mpio. Ricaurte, Reserva Natural La Planada, 1800 m, *W. Beltran 38* (MO). ECUADOR. **Carchi:** Rio San Juan Valley, 4-hr. walk below Chical, 1230–1250 m, *B. Boyle, A. Butler & E. Lloyd 2009, 2025, 2091* (all at MO); Cerro Golondrinas in upper Rio Blanco Valley, 1750–1800 m, *B. Boyle, P. O'Hara & A. Tynberg 1519* (MO); Rio Blanco drainage above Chical, 1300–1500 m, *A. Gentry & G. Shupp 26553, 26566* (both at MO).

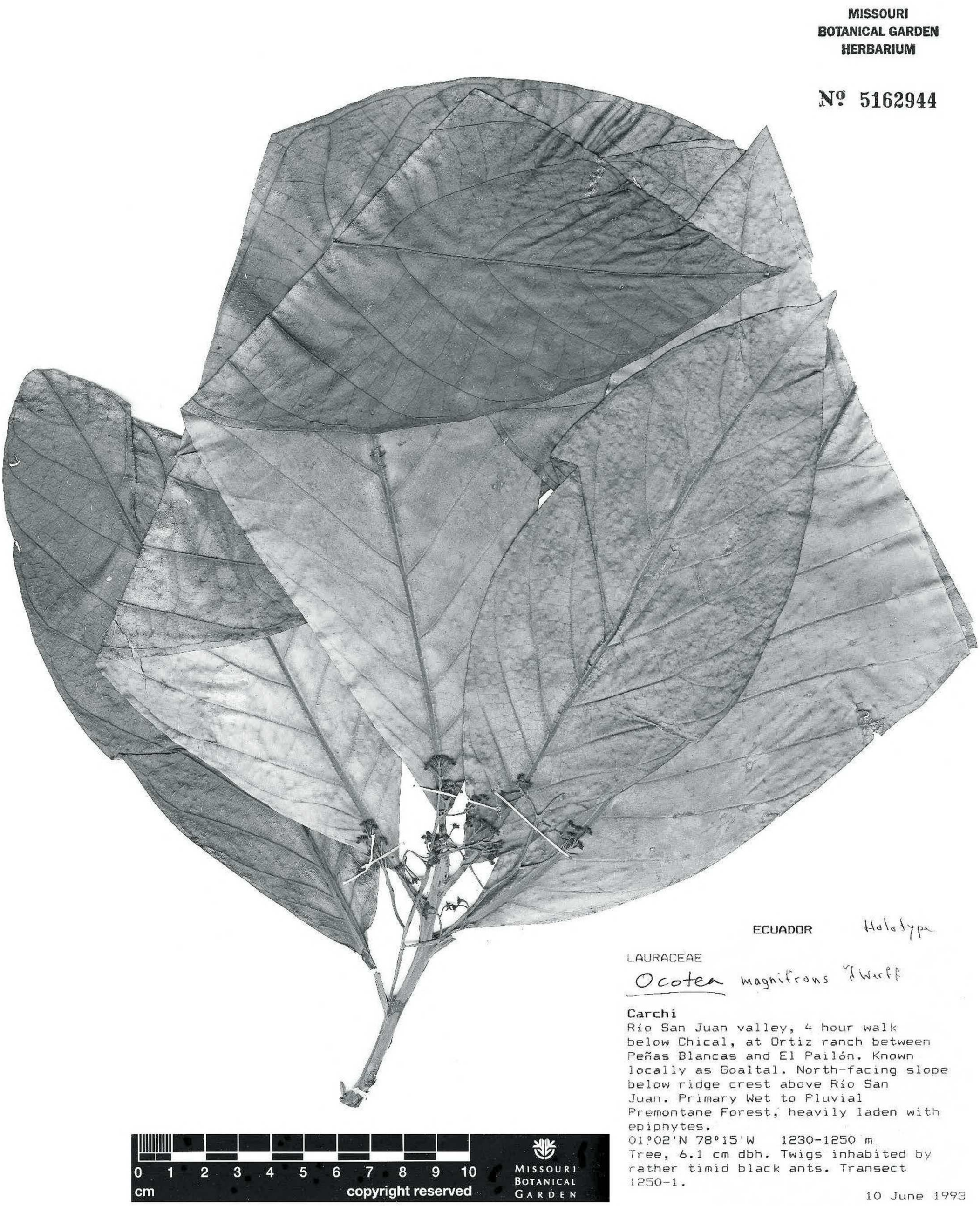

Figure 5. Holotype of *Ocotea magnifrons* van der Werff (*Boyle et al. 2063*, MO-5162944).

7. Ocotea obovatifolia van der Werff, sp. nov. TYPE. Ecuador. Bolívar: along rd. Chillanes–El Tambo, 1700–2300 m, 19 July 1991, *H. van der Werff, B. Gray & G. Tipas 12490* (holotype, MO-6327502; isotypes, B, COL, F, HBG, K, MA, NY, QCA, QCNE, US). Figure 6.

Ocoteae magnifrondi van der Werff similis, sed ab ea foliis obovatis, venatione camptodroma et ramulis adpresse pubescentibus recedit.

Trees, to 10 m; twigs sharply angular, hollow, 6–10 mm diam., moderately appressed pubescent; terminal buds densely appressed pubescent. Leaves 15–30 ×

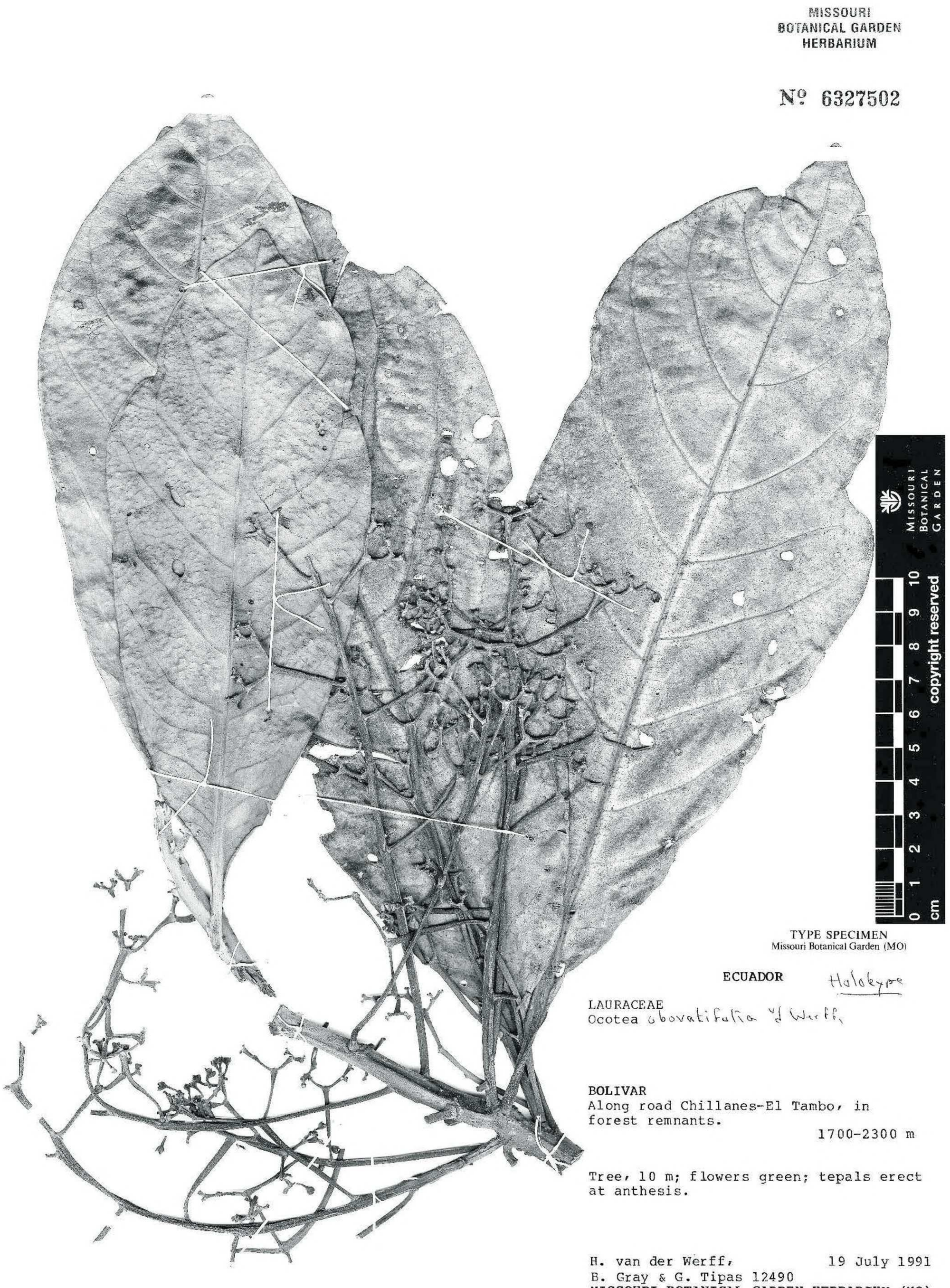

Figure 6. Holotype of *Ocotea obovatifolia* van der Werff (*van der Werff et al. 12490*, MO-6327502). Fruits are from *van der Werff et al. 12503* (MO).

6–13 cm, alternate, obovate or obovate-elliptic, thinly chartaceous, the base attenuate or acute, flat or slightly inrolled, the apex obtuse or rounded, glabrous or very sparsely appressed pubescent on the lower surface; venation immersed on the upper surface; venation slightly raised on the lower surface; domatia absent; secondary veins 6 to 9 on each side of the leaf, curved upward near the margin, but not loop-connected; petioles 12–19 mm, flat, not winged, with a similar indument as the twigs. Inflorescences

10–27 cm, paniculate-cymose, in the axils of leaves, moderately appressed pubescent. Flowers green, 3 mm diam., pedicels 4–5 mm; tepals 1.5 mm, broadly elliptic, appressed pubescent on the outer surface, glabrous or nearly so on the inner surface; stamens 9, all 4-celled, 1 mm, the anthers ca. 0.6 mm, glabrous, the outer 6 with the locelli introrse, inner 3 with the locelli lateral-extrorse and 2 globose glands at the base of the filament; staminodia not seen; pistil 1.8 mm, glabrous, the stigma plate-like, conspicuous, receptacle cup-shaped, glabrous inside. Fruit ellipsoid, 4.5 × 1.8 cm, cupule shallow, plate-like, with a single margin, 1 cm diam., the pedicel thickened.

Discussion. *Ocotea obovatifolia* can be recognized by the combination of fistulose twigs, leaves with an obtuse or rounded apex, relatively few pairs of secondary veins for the size of the leaves, and the large fruits seated on a small cupule. Immature cupules are cup-shaped, gradually narrowed into the pedicel, and have persisting tepals (*Croat 55777*, MO). At maturity, the cupule is plate-like, and the tepals have fallen off.

Ocotea obovatifolia can be confused with *O. magnifrons*; the two species differ in leaf shape (obovate in *O. obovatifolia* vs. elliptic in *O. magnifrons*), venation (secondary veins free in *O. obovatifolia* vs. distally loop-connected in *O. magnifrons*), and indument (hairs on twigs of *O. obovatifolia* appressed vs. those of *O. magnifrons* extremely short and largely erect).

Ocotea obovatifolia is known from five collections, all made on the western slope of the Andes in Ecuador. Flowering specimens were collected in April and July.

Paratypes. ECUADOR. **Bolivar:** along rd. Chillanes–El Tambo, 1700–2300 m, 19 July 1991, *H. van der Werff, B. Gray & G. Tipas 12492, 12503* (both at MO). **Cotopaxi:** 6 km NW of El Corazon on rd. to Quevedo, 1030 m, *T. Croat 55751, 55777* (both at MO).

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